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EXAMINER
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**BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES**

Application Number: 10/776,672  
Filing Date: February 11, 2004  
Appellant(s): PAVEL ET AL.

**MAILED**  
**JAN 22 2008**  
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Alan Taboada  
For Appellant

**EXAMINER'S ANSWER**

This is in response to the appeal brief filed 11/02/2007 appealing from the Office action mailed 02/21/2007.

**(1) Real Party in Interest**

A statement identifying by name the real party in interest is contained in the brief.

**(2) Related Appeals and Interferences**

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

**(3) Status of Claims**

The statement of the status of claims contained in the brief is correct.

**(4) Status of Amendments After Final**

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

**(5) Summary of Claimed Subject Matter**

The summary of claimed subject matter contained in the brief is correct.

**(6) Grounds of Rejection to be Reviewed on Appeal**

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

**(7) Claims Appendix**

The copy of the appealed claims contained in the Appendix to the brief is correct.

**(8) Evidence Relied Upon**

2001/0027023	Ishihara	10-2001
US 2002/0135761	Powell	09-2002

US 2002/0151156                      Hallock et al.                      10-2002

US 6,419,801                          Smith, Jr. et al.                      07-2002

**(9) Grounds of Rejection**

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1, 7, 9, 16, 21-22, 31-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ishihara (US 2001/0027023 A1) in view of Powell et al. (US 2002/0135761 A1).

Respect to claims 1 and 16, Ishihara discloses a method for removing/etching photoresist layer (organic layer, paragraph 0116) comprising the step of:

position the substrate comprising a photoresist layer into a processing chamber (See Fig 1);

removing the photoresist layer using a plasma (paragraph 0119-0135);  
monitoring the plasma for byproduct hydrogen optical emission, CO optical emission, or by reagent oxygen optical emission during the process (paragraph 0135-0136).

terminate the removing process according to the intensity result of emission peak wavelength of byproduct hydrogen or reagent oxygen

Ishihara does not explicitly disclose monitoring the plasma for both reagent and byproduct optical emission and stopping the etching upon the byproduct optical emission obtain a first level and the reagent optical emission obtaining a second level. However, Ishihara clearly measure the intensity of light emission of hydrogen (i.e. by product), oxygen (reagent), CO, or the like (paragraph 136). In paragraph 135, Ishihara discloses the monitoring the emission of CO and hydrogen, or oxygen (O) and using the

information from the monitoring to control the switching time. Powell teaches to monitor the optical emissions of the plasma at plurality of wavelength including hydrogen emission and oxygen emission and stopping the etching process base on the optical emission of hydrogen and oxygen gas (paragraph 0030, 0036, 0041, 51 fig 11). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Ishihara in view of Powell by monitoring plurality of optical emission including both hydrogen and oxygen emission and stopping the etching process based on the optical emission of both signal because this will result in a more accurate endpoint and help us to evaluate the progression of the plasma recipe. Further, Ishihara clearly disclose it is possible to monitor plurality of emission at the same time in order to control the endpoint (i.e. switching time).

Respect to claim 35, Ishihara discloses a method for removing/etching photoresist layer (organic layer, paragraph 0116) comprising the step of:

position the substrate comprising a photoresist layer into a processing chamber (See Fig 1);

etching the photoresist layer using a plasma (paragraph 0119-0135);

determining an endpoint by monitoring the plasma for a reagent optical emission of oxygen or a byproduct optical emission of hydrogen (paragraph 0135-0136).

Ishihara fails to explicitly disclose the step of determining an early endpoint and final endpoint by monitoring plasma reagent optical emission and byproducts optical emission. However, Ishihara clearly teaches to monitor reagent optical emission (oxygen emission) or byproduct emission (hydrogen emission). Powell teaches to

monitor the optical emissions of the plasma at plurality of wavelength including oxygen emission (early endpoint) and hydrogen emission (final endpoint) and stopping the etching process base on the optical emission of oxygen (read on early endpoint) and hydrogen gas (read on final endpoint) (paragraph 0030, 0036, 0041, 51, 0053fig 11). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Ishihara in view of Powell by monitoring both early endpoint and final endpoint because this will result in a more accurate endpoint and help us to evaluate the progression of the plasma recipe.

Respect to claims 7, 21 and 36, Ishihara teaches to monitor byproduct hydrogen optical emission occurs at a wavelength of about 656 nm while etching (paragraph 0136). Powell also teaches to monitor the hydrogen optical emission occurs at a wavelength of about 656 nm (Fig 11).

Respect to claims 9, 22 and 37, Ishihara discloses to monitor the reagent oxygen optical emission occurs at a wavelength of about 777 nm while etching (paragraph 0136). Powell also teaches to monitor the oxygen optical emission occurs at a wavelength of about 777 nm (Fig 11, paragraph 51). The limitation of claim 38 has been discussed above.

Respect to claims 31, 33, 39 Powell teaches to determine the condition of the plasma source (Fig 5-6, 9-10, paragraph 0028-0032). Respect to claims 32, 34, 40, Powell teaches to determine the condition of the interior of the processing chamber (paragraph 0051-0053).

Respect to claims 41, 44-45, Ishihara fails to disclose the step of determining from at least one of the monitored optical emissions whether a cleaning cycle is necessary, whether components within the chamber are degrading, or both. Powell teaches to use the monitored optical emissions to determine condition of the chamber (paragraph 0051-0053). According to Powell, a determination is made as to whether the chamber is clean enough. It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Ishihara in view of Powell to determine from the monitored optical emissions whether the cleaning cycle is necessary or the component within chamber are degraded (i.e. dirty) because cleaning the chamber help to reduce residues formed on the semiconductor wafer during the plasma process.

The limitation of claims 42-43 has been discussed above (See claim 35).

Claims 2, 6, 14, 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ishihara and Powell as applied to claims 1, 7, 9, 16, 21-22, 31-45 above, and further in view in view of Hallock et al. (US 2002/0151156).

Respect to claims 2 and 17, Ishihara and Powell fail to disclose the photoresist layer comprises a harden crust layer. However, Ishihara clearly teaches to implant ion such as boron, phosphorous, arsenic into the photoresist layer. Hallock teaches implant boron, phosphorous or arsenic ion to form a harden crust layer (paragraph 0018). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Ishihara and Powell in view of Hallock by having a harden crust layer because it will prevent ion from penetrating into the surface of the substrate.

Respect to claims 6, 14, Hallock discloses the optical emission having first level during etching and second level after the crust is removed and third after the photoresist is removed (Fig 2-3).

Claims 28, 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ishihara and Powell as applied to claims 1, 7, 9, 16, 21-22, 31-45 above and further in view in view of Smith Jr. et al. (US 6,419,801).

Respect to claim 28, 30, Ishihara and Powell fail to disclose the step of comparing the monitoring optical emissions to a fingerprint of a clean chamber. However, Powell clearly teaches to use the optical emission to determine when the chamber is clean enough and to produce a desired chamber condition (paragraph 0052). Smith teaches to comparing the monitored optical emissions of a "healthy" plasma chamber in order to determine whether the chamber is in condition for cleaning (e.g. "dirty/unhealthy" plasma condition) (See col. 81, read on "comparing the monitored optical emissions to a fingerprint of a clean chamber"). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Ishihara and Powell in view of Smith by comparing the optical emission to the finger print of a clean chamber (i.e. "healthy plasma chamber") because it helps us to determine when the chamber is need to clean base on a set of standard.

#### **(10) Response to Argument**

##### **1A. §103    Claims 1, 7, 9, 16, 21-22 and 31-45**



In response to Appellant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Specifically, the Appellant state that "Ishihara fails to teach or suggest monitoring a plasma used for removing (claim 1) or etching (claims 16, 35) a photoresist layer for both a byproduct optical emission and a reagent optical emission, as recited in independent claims 1, 16 and 35". This argument is not commensurate with the ground of rejection. In the final rejection, the examiner clearly recognizes that Ishihara fails to disclose the plasma for both reagent and byproduct optical emission. However, Powell clearly teaches to monitoring a plurality of optical emission including both hydrogen and oxygen emission to determine the endpoint (paragraph 0030, 0036, 0041, 0047, 0051, 0053, Fig 11).

The Appellant further states that "Powell fails to teach or suggest monitoring a plasma in a process chamber used for removing or etching a photoresist layer. To the contrary, Powell teaches forming a second plasma external to the chamber and to any plasma formed therein (for example during a cleaning process as given in one example by Powell". This argument is not commensurate with the scope of the claim. There is no limitation in the claim which exclude the use of external chamber. Further, there is no limitation in the claim which requires the step of monitoring the plasma must be perform in the same chamber with the chamber containing the substrate.

The Appellant further disagrees on the examiner disagrees with the examiner's interpretation of "a peak appearing early in the cleaning process as an early endpoint indicator and a peak that occurs later in the process as a final endpoint detection" in Powell's reference. According to Appellant, "the closest change in the emission spectrum that the Examiner contends to interprets as an early endpoint indicator occurs at a point less than half through the process". This argument is not commensurate with the scope of the claim. There is no limitation in the claim indicate the relative time of the "early endpoint indicator" with respect to the final endpoint indicator or with respect to the whole process. Further, there is no limitation in the claims which exclude that the early endpoint indicator occurs at a point less than half through the process.

1B. §103 Claims 31, 33 and 39

The Appellant further state that "the Appellant can find no teaching or suggestion of a determination of a condition of the plasma source in the cited portion of Powell". According to Appellant, Powell is "silent with respect to plasma sources, let alone determining the condition of the plasma source". The examiner disagrees. The examiner acknowledges that Powell does not use the term "plasma source". The examiner interprets the condition of the plasma source comprises any condition that related to the plasma source including emission spectrum, wavelength, and gas flow rate of the plasma. Powell clearly discloses determine the change or condition of the wavelength of the plasma, emission of the plasma (Fig 9), gas flow rate of the plasma (fig 10). It is noted that the Appellant does not claim what specific condition or

parameter of the plasma source that Appellant would like to determine in claims 31, 33 or 39.

1C. §103 Claims 41, 44 and 45

The Appellant further states "Powell provides a chamber clean process that may be monitored to determine when the chamber clean is complete - not whether a chamber clean is necessary to begin with. (See Powell, ¶¶ [0051]-[0053].) Accordingly, if one were to modify Ishihara in view of Powell, the resultant process would be an independent chamber clean process run prior to or after the process of Ishihara during which optical emission monitoring of an external process effluent may be used to determine when the chamber clean process is complete. Such a process fails to teach or suggest removing (or etching) a photoresist layer using a plasma.. and determining from at least one of the monitored optical emissions [of the photoresist etch or removal process] whether a cleaning cycle is necessary, whether components within the chamber are degrading, or both, as recited in the claims." The examiner disagrees. Powell teaches to monitoring the plasma emission spectrum in real time during the chamber cleaning process from the beginning to the end in order to monitor the condition of the chamber and to determine when the chamber is clean enough (paragraph 0051-0053). Of course, before the endpoint was reached, the cleaning cycle is necessary and the cleaning process is continued until the chamber is determined as "clean enough" (paragraph 0052). Further, Powell also discloses the step of monitoring depletion of material in real time from chamber during cleaning enable timing, control and validation of the cleaning process to determine a

characterization of the chamber condition (See paragraph 0051, Fig 11). Base on these teaching, the examiner still maintains that Powell teaches to monitor the optical emission to determine whether the cleaning are necessary or whether the components with the chamber are degrading or both.

2. §103 Claims 2, 6, 14, and 17.

Respect to claim 2, 6, 14 and 17, the Appellant states "Hallock discloses a method for removing a hardened crust on a photoresist after exposure an ion implantation process. However, like Ishihara and Powell, Hallock also fails to teach or suggest monitoring a plasma used for removing or etching a photoresist layer for both a byproduct optical emission and a reagent optical emission, as recited in independent claims 1 and 16. As such, Hallock fails to teach or suggest a modification to the teaching of Ishihara and Powell that would result in limitation recited in the claims". The examiner disagrees. The specific teaching of Ishihara and Powell has been discussed above. Specifically, the examiner still maintains that the combination of Ishihara and Powell teaches monitoring a plasma used for removing or etching a photoresist layer for both a byproduct optical emission and a reagent optical emission. Further, the examiner still maintain the it is obvious to combine Ishihara, Powell and Hallock for the reason as stated above in the 103 rejection.

3. §103 Claims 28, 30

Respect to claims 28, 30, the Appellant state "However, like Ishihara and Powell, Smith also fails to teach or suggest monitoring a plasma used for removing or etching a photoresist layer for both a byproduct optical emission and a reagent optical emission,

as recited in independent claims 1 and 16". The examiner disagrees. The specific teaching in Ishihara and Powell and the response to argument to Ishihara and Powell's teaching have been discussed above. Specifically, the examiner still maintains that the combination of Ishihara and Powell teaches monitoring a plasma used for removing or etching a photoresist layer for both a byproduct optical emission and a reagent optical emission. Further, the examiner still maintains the it is obvious to combine Ishihara, Powell and Smith for the reason as stated above in the 103 rejection.

**(11) Related Proceeding(s) Appendix**

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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